



IBM Global Technology Services

IBM Project Big Green Delivering Client Value

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Data centers are at a tipping point and energy use and cost is the driver

Increased Computing Demand

- Between 2000 and 2010 server installations will grow by 6x and storage by 69x. Wintel and Unix server utilization low – 3 to 30% – *IBM / Consultant studies*

Changing Cost Dynamics

- Per square foot, annual data center energy costs are 10 to 30 times more than those of a typical office building.² - *William Tschudi, March 2006*

Data Center Lifecycle Mismatch

- Data centers have doubled their energy use in the past five years.³ - *Koomey, February 2007*
- US commercial electrical costs increased by 10% from 2005-06.⁴ - *EPA Monthly Forecast, 2007*
- “Eighty-seven percent of data centers were built before 2003”⁵
- “Twenty-nine percent of clients identified” data center capability affected server purchases ”- *Ziff Davis*

1. Gartner, *Data Center Power and Cooling Scenario Through 2015*, Rakesh Kumar, March 2007.

2. William Tschudi, March 2006.

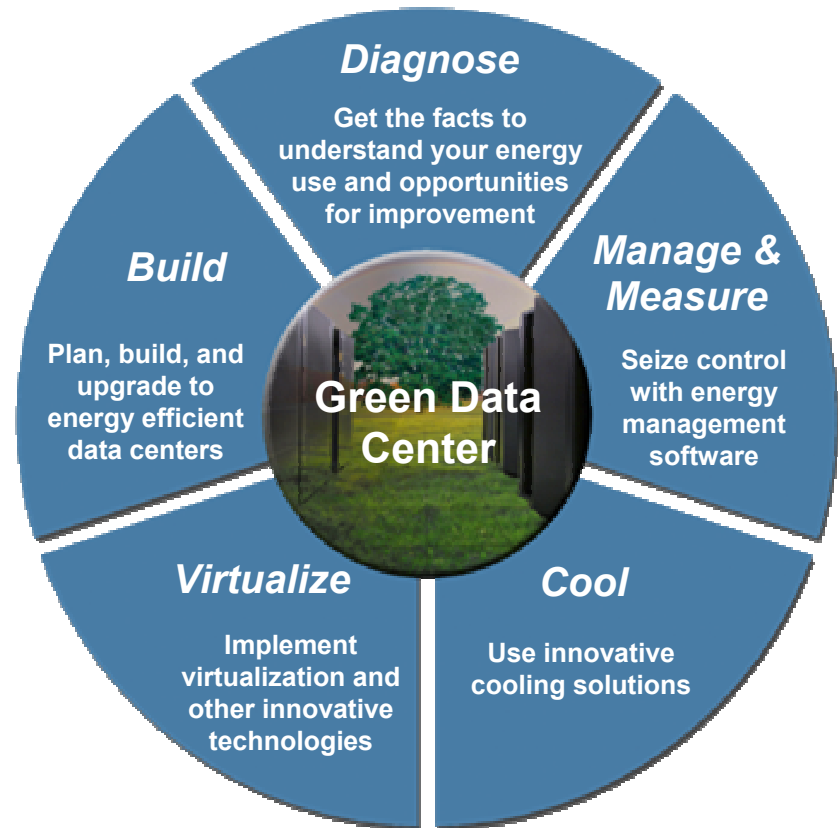
3. Koomey, February 2007.

4. *EPA Monthly Forecast, 2007.*

5. Nemertes Research, *Architecting and Managing the 21st Century Data Center*, Johna Till Johnson, 2006.

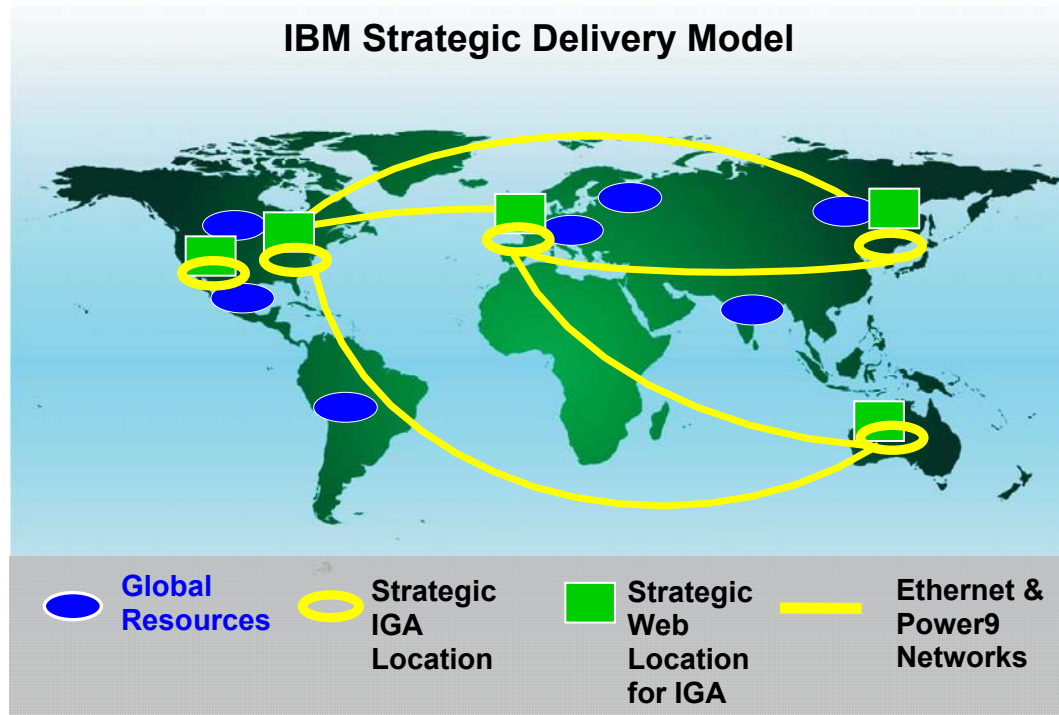
Project 'Big Green'

- **IBM to reallocate \$1 billion each year**
 - Accelerate “green” technologies and services
 - Provide a roadmap for clients to address the IT energy challenges
 - Offer IBM solutions that include the strength of IBM’s hardware, software, services, research and financing teams
- **Business growth and energy conservation**
 - Double the compute capacity by 2010 —without increasing power consumption or CO₂ emissions avoiding 5B kilowatt hours per year
 - Focus on data center energy conservation as data centers are 6% of the total space but consume 30% of the energy cost
- **Going Green impacts pocket-book and the planet**
 - Business: Double your IT capacity
 - Operational: Save 45% energy savings or \$1.3M per year
 - Environmental: 1,300 less cars or 3.5 M pounds of coal



IBM Data Center Global Expertise

A decade of managing 8M square feet of data centers around the world



TECHNOLOGY

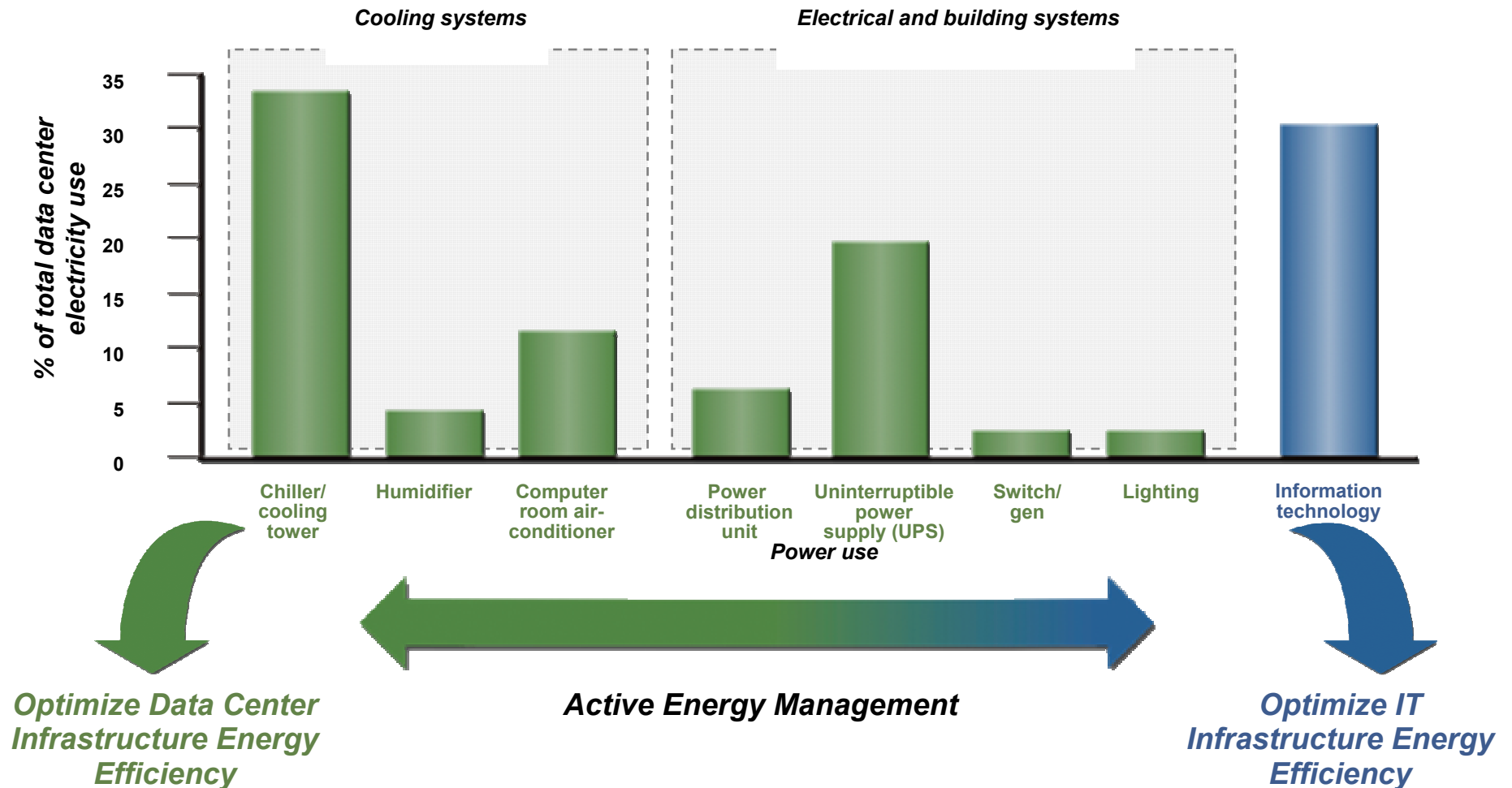
IBM Metrics	1997	Today
CIOs	128	1
Host data centers	155	7
Web hosting centers	80	5
Network	31	1
Applications	15,000	4,700

Plus...Deep experience in helping our clients data center challenges

- Significant services deployment capability: over 3,300 resources for server, storage and data centers
- Global breadth: built >30M square feet of data centers; top 5 Chinese banks; India & Egypt telecomm
- Leverage experience from managing and deploying over 200,000 servers in over 400 centers

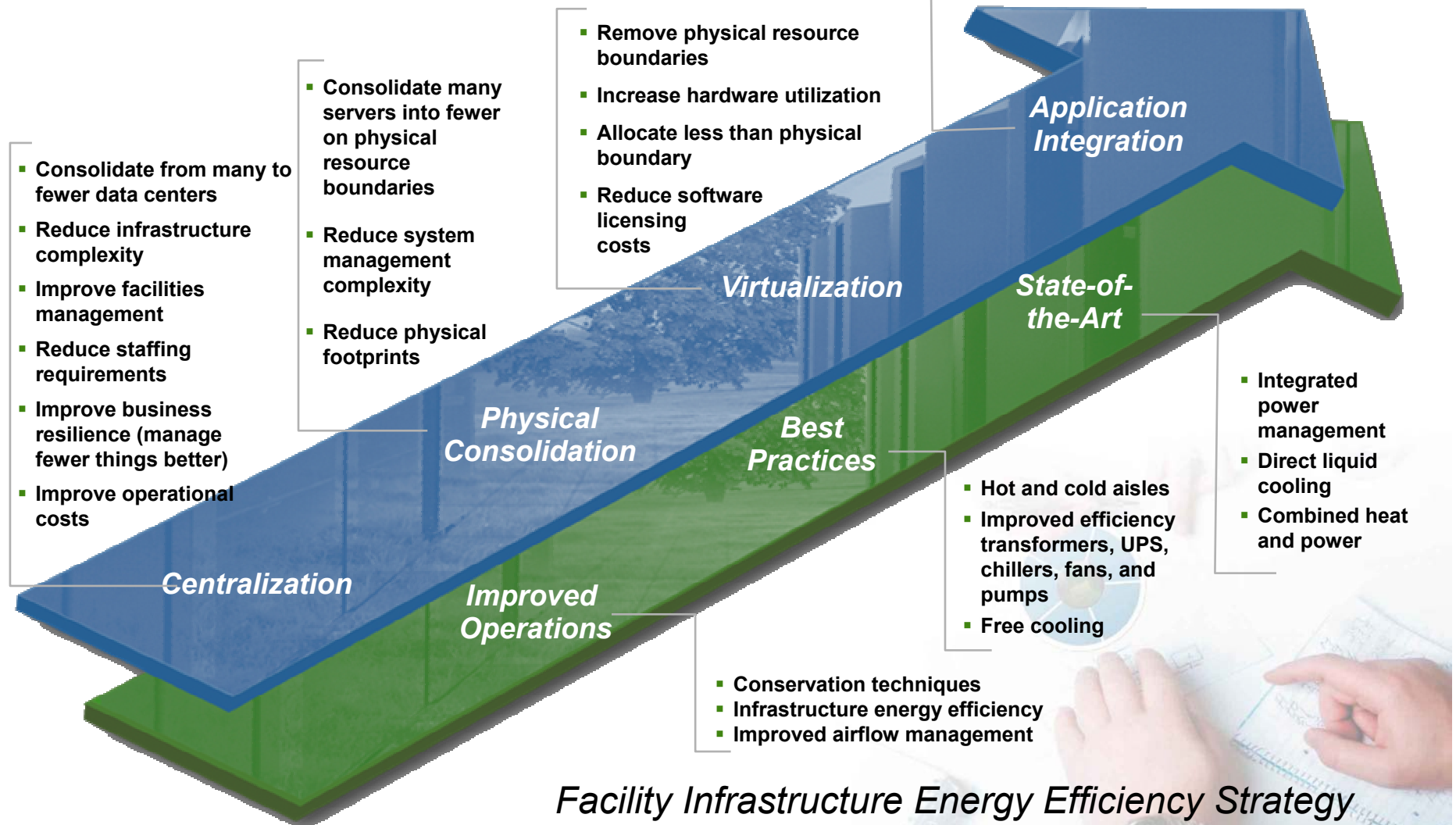
Where does the energy go?

The data center energy challenge affects both the physical data center and the IT infrastructure



IBM Data Centers

IT Infrastructure Energy Efficiency Strategy



Facility Infrastructure Energy Efficiency Strategy

Environmental Protection Agency Report to US Congress

Scenario / Percent Energy Savings	IT Equipment	Site Infrastructure (Power and Cooling)
Improved operation		
20%	<ul style="list-style-type: none"> Continue current trends for server consolidation Eliminate unused servers Adopt “energy-efficient” servers to modest level Enable power management on 100% of applicable servers Assume modest decline in energy use of enterprise storage equipment 	30% improvement in infrastructure energy efficiency from improved airflow management
Best practice		
45%	<p>All measures above plus:</p> <ul style="list-style-type: none"> Consolidate servers to moderate extent Aggressively adopt “energy-efficient” servers Assume moderate storage consolidation 	<p>Up to 70% improvement in infrastructure energy efficiency from all measures in “Improved operation” scenario, plus:</p> <ul style="list-style-type: none"> Improved transformers and uninterruptible power supplies Improved efficiency chillers, fans, and pumps Free cooling
State-of-the-art		
55%	<p>All measures above plus:</p> <ul style="list-style-type: none"> Aggressively consolidate servers Aggressively consolidate storage Enable power management at data center level of applications, servers, and equipment for networking and storage 	<p>Up to 80% improvement in infrastructure energy efficiency, due to all measures in “Best practice” scenario, plus:</p> <ul style="list-style-type: none"> Direct liquid cooling Combined heat and power

Source: EPA Response to Congress for Public Law 109-431, 08/07/07

Web-based tool provides an energy efficiency self assessment

Free self assessment available on the web to highlight opportunities for energy efficiency improvement

Assessment Process

- **Twelve questions on energy usage**
- **Three main categories**
 - Awareness of power related issues
 - Deployment of tactical quick hitters
 - Extent of strategy data center planning
- **Report on improvement areas**
- **IBM Service recommendations**

Data Center Efficiency Self-Assessment Tool

1 2 3 4 5 6 7 8 9 10 11 12

Energy Efficiency
You can't manage what you can't measure. Measuring the energy efficiency of your data center requires knowledge of your energy usage.

Do you know how efficient your data center infrastructure is for the delivery of power and cooling to the IT equipment?

To a great degree

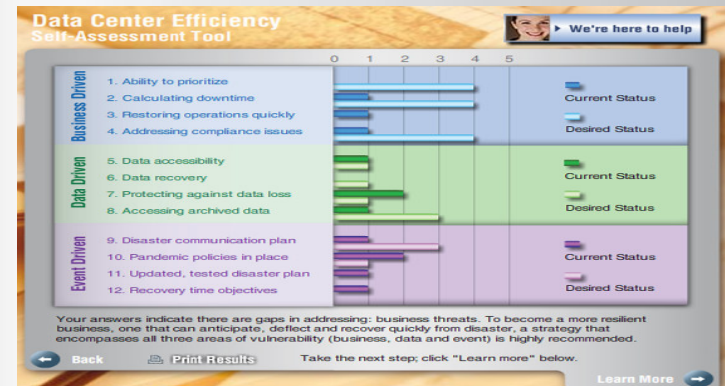
5
4
3
2
1
0
Not at all

Would a common metric for comparing the power and efficiency of your data center to other data centers be useful to you?

To a great degree

5
4
3
2
1
0
Not at all

Next



www.ibm.com/itsolutions/optimizeit/cost_efficiency//energy_efficiency/services.html

Diagnose – Data Center Energy Efficiency Assessment

Provide facts to reduce energy consumption by 53% annually



Client requirements

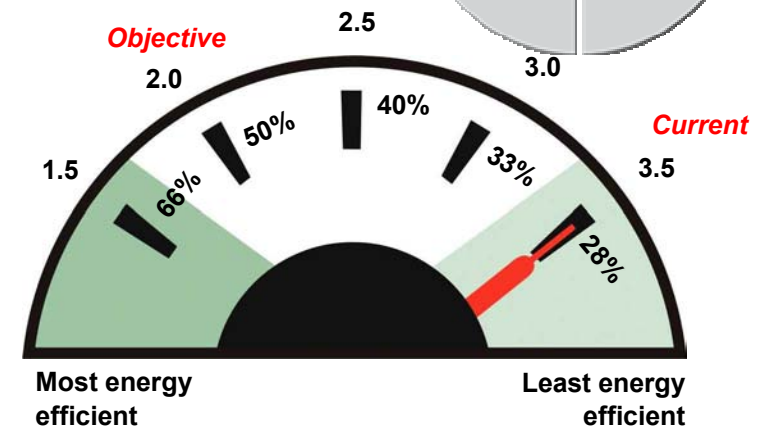
- Support IT growth with an existing 5,000 sq ft center
- Improve data center energy efficiency & reduce costs

Solution

- Comprehensive, fact-based analysis
- Evaluate cooling system components, electrical systems and other building systems
- Provide baseline metric (MPG) for data center energy efficiency
- Deliver roadmap of cost justified recommendations

Benefits

- Up to 53% annual energy savings
- 40% annual savings on actions with < 2 year payback
- \$125-170K annual energy savings



Improvements	Cost (\$K)	Payback
Reduce recirculation & bypass of cooling air	< 5	< 1 year
Increase CRAC air discharge temperature	< 5	<1 year
Adjust indoor temperature & relative humidity	< 3	<1 year
Turn off CRAC's where no IT equipment load	< 1	immediate
Improve UPS efficiency	40-140	1-2 years
Consider transferring IT loads to two PDUs	Varies	varies
Implement occupancy sensor light controls	< 5	1.5 years
Variable speed fans	200	6 years
Variable speed scroll compressors	300	18 years
Total	60 - 700	1 To 18 years

Diagnose – Data Center Energy Efficiency Assessment - IBM Lexington

Extend useful life of an 84K square foot center with 15% energy savings from physical infrastructure efficiencies



Client requirements

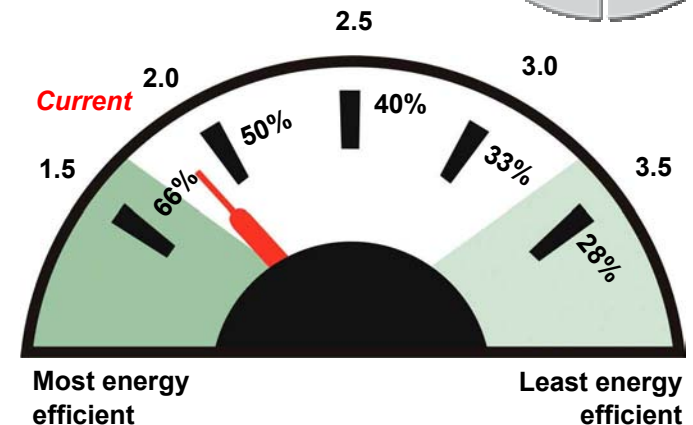
- Not able to grow energy and cooling capacity in existing 84K sq ft data center
- Need to reduce energy used by physical infrastructure to grow IT equipment

Solution

- Comprehensive, fact-based analysis
- Evaluate cooling system components, electrical systems and other building systems
- Provide baseline metric (MPG) for data center energy efficiency
- Deliver roadmap of cost justified recommendations

Estimated Benefits

- 15% annual energy savings from physical infrastructure
- \$55-65K annual energy savings in an efficient center
- All investments have < 2 year payback

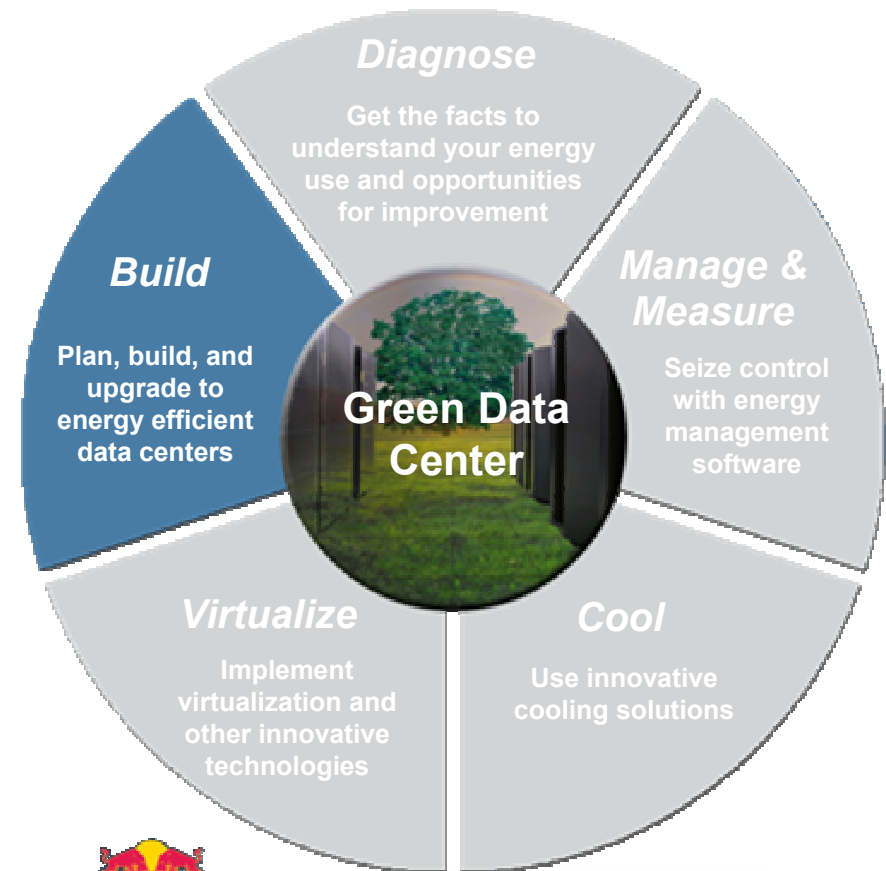


Improvements	Cost (\$K)	Payback
Air management improvements: floor gaps, blanking plates, tile placement	< 5	< 1 year
Align servers using hot / cold aisle techniques	<10	< 1 year
Increase chilled water temperatures	< 5	<1 year
Increase supply air temperatures from CRAC's	< 3	<1 year
Re-commission water side economizer for "free cooling"	~ 50 to 100	< 2 years
Total	75 - 125	< 2 years

Build – plan, build and upgrade to energy efficient data centers

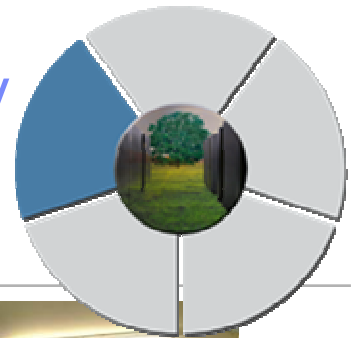
■ IBM and our clients are seeing results from data center builds

- \$180M reduction in annual operating expenses from consolidating 38 to 2 data centers and improving business resilience (China)
- \$7.2 M USD in annual operational savings for consolidating 4 centers into one 3,800 square foot data center (Germany)



Build - Scalable Modular Data Center-Bryant University

Rapid deployment of a traditional data center at 20% less cost than a traditional data center raised floor



Client requirements

- Decentralized IT infrastructure was costly, inefficient and increasingly unable to scale to growing demands for IT services
- Needed to consolidate to an enterprise-class data center

Solution

- Implemented an IBM Scalable Modular Data Center solution with advanced InfraStruXure® architecture from IBM Alliance Partner APC
- Standardized on IBM BladeCenter® for virtualized Microsoft® Windows® and Linux®
- Saves on power and cooling costs; can provision new virtual servers in < 1 day

Benefits

- Reduced physical servers from 75 to 40
- 40 to 50 percent reduction in floor space requirements
- Contributed to reduced carbon footprint and reduced power consumption/cooling



“The IBM and APC solution is more efficient, targeting cooling on the components that need it, rather than wasting energy chilling the surrounding air.”

— Rich Siedzik, Director of Computer and Telecommunication Services, Bryant University

Build - Supercomputing Center- MareNorstrum

Leadership power and cooling design to support #1 supercomputing data center in Europe



Client requirements

- Build the #1 supercomputing data center in Europe
- Install 2,560 blades - 94.21 terra flops
- 4 months - construction start to functional center
- Support 2-3 generations of technology changes

Solution

- Build it in only 1,600 square feet
- Design the power and cooling within the constraints of an 18th-century church
- Support state-of-the-art, high-density IT equipment
- Provide flexible design to allow for technology upgrades
- And ... make it beautiful



Benefits


- Supports 21KW/rack (400 W/sq ft) of cooling
- Flexibility for the future – supercomputing performance upgrade underway
- World's most beautiful supercomputing center
- On our third system upgrade in the same facility



Build - Data Center Expansion- IBM Boulder

Add 72,000 square feet to a highly resilient center to include energy efficiency as a design point



IT Related	Facilities Related	Industry Related
<p>Design / Build</p> <ul style="list-style-type: none"> ▪ Economies of scale – 300,000 sq ft ▪ Power Density - 90 watts / sf (modular to 140) ▪ Best Practices Equipment Layout ▪ No Single Points of Failure ▪ Tier 3 design point <p>Operate</p> <ul style="list-style-type: none"> ▪ Virtualized High Utilization Workload ▪ Demand modeling for future requirements ▪ Three dimensional space and power billing ▪ Low Green Grid PUE metric ▪ Integrated Power Management Software ▪ Liquid cooled equipment ▪ Low long term TCO 	<p>Cooling</p> <ul style="list-style-type: none"> ▪ Free cooling > 50% ▪ Chiller water Pumping/Air handling units variable speed drives ▪ DC CRAC Motors <p>Electrical</p> <ul style="list-style-type: none"> ▪ Modular power density expansion options <p>Other building systems</p> <ul style="list-style-type: none"> ▪ Energy Efficient Lighting ▪ High “R” Value Insulation 	<p>LEED Certification Objective</p> <p>Energy Management Programs (\$700K)</p> <ul style="list-style-type: none"> ▪ Power Company Rebates ▪ Government Incentives ▪ Renewable Energy Certificates <p>Environmental Programs</p> <ul style="list-style-type: none"> ▪ Wind Power Generation (1,000 MW) ▪ Reduced CO₂ emissions 

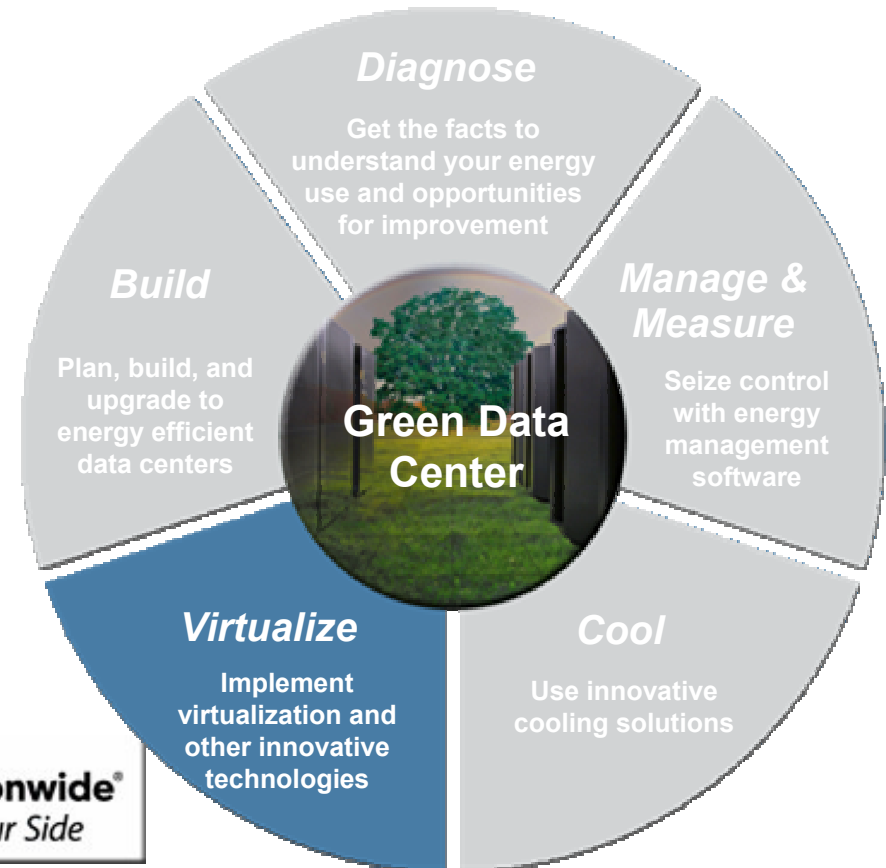
Virtualize – Implement virtualization and other innovative technologies

■ IBM and our clients are seeing results from virtualization of servers and storage

- Double storage utilization with SAN Volume Controller
- Up to 10:1 are typical server consolidation results¹

“Energy efficiency is the number one priority for PG&E as we work with our customers to meet our environmental goals. We’re thrilled to partner with IBM to pilot energy efficiency innovations that can help our customers save money and protect the environment by further reducing their energy use.”

Brad Whitcomb,
VP, Customer Products & Services,
PG&E



Cool – University Supercomputer Center

Innovative design using IBM cooling technologies to support highest computational performance and save \$780K in costs

Client requirements

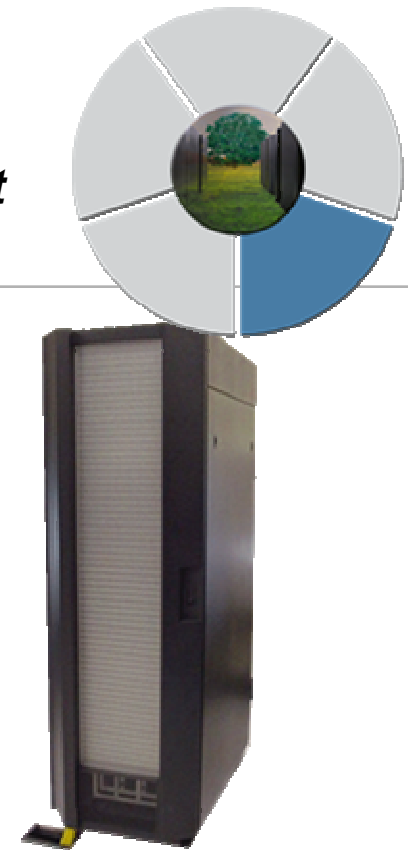
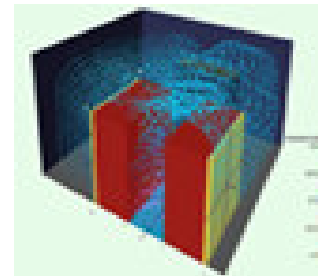
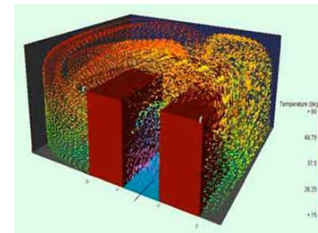
- Highest possible computational performance
- Address heat output from ultra-dense blade servers
- Limited by budget and floor space

Solution

- IBM System Cluster 1350 with 1,000 IBM BladeCenter® LS20 nodes each with four AMD Opteron cores
- Combines standard air conditioning and IBM Rear Door Heat eXchanger
- Unique data center design with open floor tiles on cold aisles and directional baffles

Benefits

- Maximum LINPACK performance of 8.5 TFlops
- Saved an estimated \$780,000 in total data center costs
 - 10-15% reduction in operating costs
 - 55% reduction in air conditioning requirements
 - 50% lower airflow requirements for less disruption and less noise



“Our innovative data center design, allied with the IBM technologies, enabled us to pack a huge amount of computing power in a compact space...more cost effective and environmentally friendly than a traditional design while offering the same compute power.” – Major US university

Cool - Data Center Stored Cooling-IBM Bromont

Implement innovative cooling technology to reduce operational costs from the largest data center energy user by 45%



Client requirements

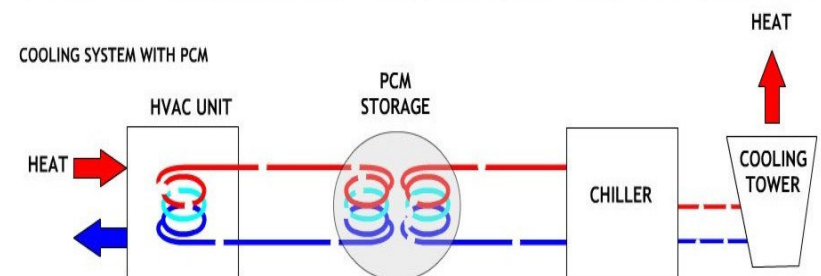
- Identify and attach the largest areas of energy consumption
- Reduce energy consumption and operating costs of chiller plant supporting Bromont (Quebec, Canada) site

Solution

- Install “Cool Battery”
- Increase chiller utilization by storing cold for use throughout the day
- Leverage environment - free cooling

Benefits

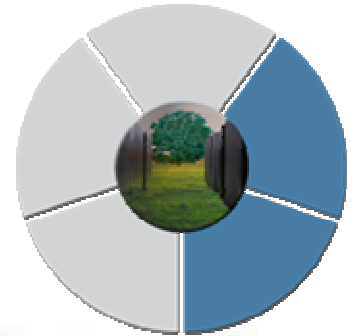
- Reduced chiller plant energy cost by 45%
 - Over 5.3 million kwhr per year
 - Demand reduction of approximately 1 MW
- Avoided need to install additional chiller
- Environmentally-friendly, non-toxic, no-maintenance



Manage and Measure

Seize control with energy management software

- **Measure/Trend Power use**
 - Help control power consumption
 - Provide energy billing metrics
- **Allocate or cap power**
 - Use power history and service levels to optimize energy use
- **Automate energy management**
 - “Cruise control” for power consumption of servers
 - Service level automation
 - Energy optimization automation



IBM PowerExecutive



Manage, Measure & Cool - IBM Southbury

Implement IBM Energy Management Solution and IBM Rear Door Heat eXchanger for 10-30% energy savings

Client requirements

- Improve how to meter, control, and cap power usage
- Actively moving workloads and power up/down resources

Solution

- Power density of 200 watts per square foot
- Use of 2-3 “Thermal Zones” for targeted power and cooling
- Power and thermal meters to measure baseline and changes
- Rack based thermal cooling

Expected Benefits

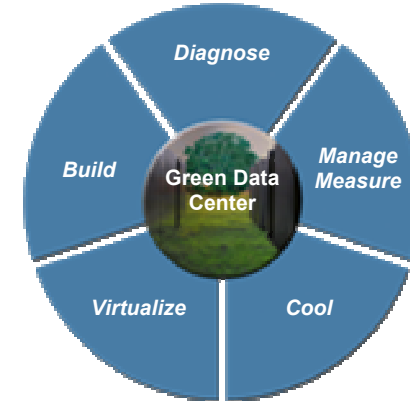
- Integrated Facilities and IT solution
- Rack Level Cooling Improves Efficiency 20-30%
- Match Cooling Load to Heat Load: 10-30% Savings
- Combined Air and Water or Refrigerant Cooling
- Reduces Equipment Costs/More Flexible Facility






IBM PowerExecutive



Benefits of a Green Data Center



From → To

Financial 	Rising global energy prices Squeeze on IT budgets Constraints on IT growth	Ability to accurately view baseline energy cost Cost savings from more efficient energy use Reduce power and cooling issues as inhibitor to business growth
Operational 	High density server systems Exploding power & cooling cost Aging data centers	More computing performance per kilowatt Shift to have more energy used by IT than physical infrastructure Extend the life of existing data centers
Environmental 	Corporate social responsibility Limited “green” public image Improve employee moral	Meaningful energy conservation and reduced CO ₂ emissions Improve “green” public image Positive impact linking corporate social responsibility and personal values

IBM Energy Efficiency Initiative: IBM Project Financing™

Planning and Preparation: Transitioning to more Energy Efficient solutions

Disposition:

Environmentally compliant disposal, data protection

- Buyback services
- Asset disposal
- Secure disk overwrite
- Packaging and transportation services



Use & Management:

Matching technological and economic life; Flexibility

Acquisition: Meeting capital requirements for your Data Center Solutions

Driving Value Throughout the Project Lifecycle

- Conserves cash
- Aligns repayment streams with anticipated project benefits
- Facilitates planning and tracking of project costs
- Improves budget management with predictable costs

Messages

- **Energy efficiency is a global issue with significant impact today — and will have an even greater impact in the future**
- **IBM Project Big Green is defining leadership in data center energy efficiency**
- **Real solutions are available today**
- **We are deploying these capabilities with our clients and within IBM**

Thank You



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